



new frontiers in bioinformatics and computational biology

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Course Syllabus
Using Bioinformatics: Genetic Research
Bio-ITEST Professional Development Workshop
August 2-13, 2010

Instructors:

Jeanne Chowning, M.S.

Bio-ITEST Principal Investigator. Director of Education, Northwest Association for Biomedical Research (NWABR). Jeanne has extensive experience leading science educational outreach programs and facilitating connections between teachers, researchers, and the public. She is also the Principal Investigator on a 5-year NIH Science Education Partnership grant to NWABR and has led the organization's professional development programs and curriculum writing efforts. She is the Co-President of the Washington State Department of Health Genetics Advisory Council and Past-President of the Washington Biotechnology Foundation.

Sandra Porter, Ph.D.

Bio-ITEST Co-Principal Investigator. Director of Education & Co-Director of Research at Geospiza, and President of Digital World Biology. Sandra has over twenty years of experience sequencing DNA, analyzing DNA sequence data, and teaching courses in molecular biology. Her current interests focus on the application of bioinformatics algorithms in genomics research and include studies on genetic variation, SNP discovery, and the use of assembly algorithms in detecting alternative splicing.

Karen A. Peterson, M.Ed.

Bio-ITEST Co-Principal Investigator. Executive Director for the Puget Sound Center for Teaching, Learning and Technology, Director of the Diversity in Technology Group, and an Evaluator with the Evaluation & Research Associates. Karen has managed two U.S. Department of Education grants designed to provide professional development opportunities to Puget Sound area teachers and serves as Principal Investigator on the National Science Foundation grant "The National Girls Collaborative Project".

Dina Kovarik, M.S., Ph.D.

Bio-ITEST Program Manager, NWABR. Dina has ten years of experience in molecular biology, obtaining an M.S. in Epidemiology and a Ph.D. in Molecular and Cellular Biology from the University of Washington working primarily on HIV/AIDS. She also worked as a Teaching Associate in the Department of Biology, Sonoma State University, and was a founding member of FOSEP, the Forum for Science, Ethics and Policy.

Program Description

Using Bioinformatics: Genetic Research is a two-week professional development experience for teachers to learn about both the Introductory and Advanced Strand Bio-ITEST lessons. Teachers will receive training in the use of bioinformatics tools to analyze DNA sequences, perform multiple sequence alignments and explore protein structure. Teachers will also have the opportunity to participate in a research study of the program and to provide critical feedback on lesson drafts.

Updated June 25, 2010

The program is funded by an *Innovative Technology Experiences for Students and Teachers* Award from the National Science Foundation and is comprised of two different units or “Strands.” The Introductory Strand, *Using Bioinformatics: Genetic Testing*, utilizes bioinformatics resources to teach basic concepts in molecular biology. The Advanced Strand, *Using Bioinformatics: Genetic Research*, builds upon the introductory lessons by incorporating additional informatics resources and includes an authentic inquiry-based investigation specifically for advanced students.

Overview

During week 1 of the workshop at Shoreline Community College, teachers will receive background in using both the Introductory and Advanced Strand materials with students, including experiencing each of the Introductory lessons themselves. After learning about the use of numerous bioinformatics resources, including the National Center for Biotechnology Information (NCBI) and the search engine *Entrez*, as well as instruction on viewing macromolecules using *Cn3D*, teachers will perform lab experiments in Shoreline’s Biotechnology Laboratory. DNA purification, polymerase chain reaction, agarose gel electrophoresis, and submission of DNA samples for sequencing will help generate data for use in the Advanced Strand lessons during week 2.

Week 2 of the workshop will be held at the EdLab Group, where teachers will receive additional background on the genes that are the focus of the Advanced Strand student research project and training in software for annotating DNA sequences, performing multiple sequence alignments, and using bioinformatics tools to study evolutionary relationships. Teachers will experience each of the Advanced lessons firsthand, and will have the opportunity to provide critical feedback on lesson drafts. In addition, teachers and project staff will spend a day touring local research institutions and talking with scientists who use bioinformatics in their work.

The Bio-ITEST program is committed to providing scientific support in the implementation of the student research project.

Research and Evaluation

In order to determine whether our program is meeting its goals, we will conduct a research study in classrooms of participating teachers. We are interested in the effect of the professional development workshop and curricula on student achievement and interest in STEM careers. The research study is also required by our funders, the *Innovative Technology Experiences for Students and Teachers* program through the National Science Foundation. All teachers who participate in the summer workshop are requested to participate in this study. However, the study is voluntary and teachers may choose to opt out at any time. Accepted candidates will participate in the two-week summer program and will complete a pre-survey (prior to the workshop) and a post-survey (at the end of the workshop). Teachers will also need to secure the support of their administration (principal or district supervisor) as part of their application. After the summer workshop, teachers will introduce the study to their students, provide instruction based on the program materials (approximately one to two weeks), administer brief (15 minute) pre- and post-surveys before and after Bio-ITEST lessons to their students, and provide the surveys to us for analysis.

National Institutes of Health Working Definition of Bioinformatics and Computational Biology

Bioinformatics: Research, development, or application of computational tools and approaches for expanding the use of biological, medical, behavioral or health data, including those to acquire, store, organize, archive, analyze or visualize such data.

Computational Biology: The development and application of data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to the study of biological, behavioral, and social systems.

<http://www.bisti.nih.gov/docs/CompuBioDef.pdf>

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Workshop Week 1:

Bio-ITEST Introductory Curriculum, *Using Bioinformatics: Genetic Testing*
 Overview of the Advanced Curriculum and Lab Experiments with DNA

Location: Shoreline Community College, Shoreline, WA

Dates: Monday, August 2 – Friday, August 6, 2010

Monday, August 2	Introductions and Using Online Resources	Location
9:00-9:30	Continental Breakfast	Room 2518*
9:30-9:45	Pre-workshop Survey Administration	Library Computer Lab
9:45-10:15	Introductions and Overview of Bio-ITEST	Library Computer Lab
10:15-10:45	Bio-ITEST Program Evaluation and the Correlational Research Study	Library Computer Lab
10:45-11:00	Break	
11:00-12:00	Discussion of Pre-Workshop Homework	Room 2932*
12:00-12:45	Lunch	Shoreline Cafeteria
12:45-1:45	Lesson 1: Bioinformatics and Genetic Testing	Library Computer Lab
1:45-2:45	Teacher Background: The National Center for Biotechnology Information (NCBI)	Library Computer Lab
2:45-3:00	Break	
3:00-4:00	Lesson 2: Navigating Online Resources	Library Computer Lab
4:00-5:00	End of Day Wrap-Up	Library Computer Lab

Tuesday, August 3	Genetic Testing: The Case of BRCA1	Location
9:00-9:30	Continental Breakfast	Room 2518*
9:30-10:45	Teacher Background: Bioethics in the Classroom	Room 2305*
10:45-11:00	Break	
11:00-12:00	Lesson 3: Exploring Genetic Testing: Case Study	Room 2305*
12:00-12:45	Lunch	Shoreline Cafeteria
12:45-1:45	The Bio-ITEST Moodle Community	Library Computer Lab
1:45-2:45	Teacher Background: The Logic of BLAST	Library Computer Lab
2:45-3:00	Break	
3:00-4:00	Lesson 4: Understanding Genetic Tests to Detect BRCA1 Mutations	Library Computer Lab
4:00-5:00	End of Day Wrap-Up	Library Computer Lab

* Room number subject to change. Any room changes will be sent via email the week before the workshop.

Wednesday, Aug 4	The Small and Big Picture	Location
9:00-9:30	Continental Breakfast	Room 2518*
9:30-10:45	Teacher Background: The Power of Cn3D	Library Computer Lab
10:45-11:00	Break	
11:00-12:00	Lesson 5: Learning to Use Cn3D	Library Computer Lab
12:00-12:45	Lunch	Shoreline Cafeteria
12:45-1:45	Lesson 6: Evaluating Genetic Tests: A Socratic Seminar Discussion	Room 2932*
1:45-2:45	Lesson 7: Vocation Stations	Library Computer Lab
2:45-3:00	Break	
3:00-4:45	Assessment: Genetic Testing: ALAD and SOD1	Library Computer Lab
4:45-5:00	End of Day Wrap-Up	Library Computer Lab

Thursday, August 5	Getting our Feet Wet: DNA in the Wet Lab	Location
9:00-9:30	Continental Breakfast	Room 2518*
9:30-10:30	Overview of the Advanced Strand Lessons and the Student Research Project	Room 2930
10:30-10:45	Break	
10:45-12:00	Teacher Background: Understanding DNA Purification & Polymerase Chain Reaction (PCR)	Room 2930
12:00-12:45	Lunch	Shoreline Cafeteria
12:45-2:45	In the Lab: DNA Purifications	Room 2930
2:45-3:00	Break	
3:00-4:30	In the Lab: Performing PCR	Room 2930
4:30-5:00	End of Day Wrap-Up	Room 2930

Friday, August 6	Gathering Data: DNA Gels and Sequencing	Location
9:00-9:30	Continental Breakfast	Room 2518*
9:30-10:45	Teacher Background: DNA Sequencing	Room 2930
10:45-11:00	Break	
11:00-12:00	In the Lab: Analyzing PCR Products by Agarose Gel Electrophoresis	Room 2930
12:00-12:45	Lunch	Shoreline Cafeteria
12:45-2:45	In the Lab: Analyzing PCR Products by Agarose Gel Electrophoresis, on-going	Room 2930
1:30-2:00	Dr. Susan Hoyne, Shoreline Community College <i>Biotechnology at Shoreline Community College</i>	Room 2930
2:45-3:00	Break	
2:30-4:00	In the Lab: Preparing and Submitting Samples for DNA Sequencing	Room 2930
4:00-5:00	End of Day Wrap-Up	Room 2930

* Room number subject to change. Any room changes will be sent via email the week before the workshop.

Workshop Week 2:

Bio-ITEST Advanced Curriculum, *Using Bioinformatics: Genetic Research* & Exploring Careers

Location: EdLab Group, Lynnwood, WA

Dates: Monday, August 9 – Friday, August 13, 2010

Monday, August 9*	Bioinformatics Research in Action	Location
9:00-12:00	Tour of Bumgarner Lab, Rosen Building	South Lake Union (Seattle)
12:00-1:00	Lunch	TBD
1:00-3:00	Tour of the Institute for Systems Biology (ISB)	ISB, Fremont neighborhood (Seattle)
3:00-4:00	Discussion: Student Career Awareness	TBD
4:00-5:00	End of Day Wrap Up	TBD

* Times are Tentative

Tuesday, August 10	Bioinformatics and Genetic Research
9:00-9:30	Continental Breakfast
9:30-10:45	Teacher Background: Overview of Bioinformatics, Barcoding & Genetic Research
10:45-11:00	Break
11:00-12:00	Lesson 1: The Process of Genetic Research
12:00-12:45	Lunch
12:45-1:45	Dr. Shawn Larson, Seattle Aquarium
1:45-2:45	Lesson 2: DNA Barcoding and the Barcode of Life Project
2:45-3:00	Break
3:00-4:00	Teacher Feedback: Advanced Strand Lessons 1 and 2
4:00-5:00	End of Day Wrap Up

Wednesday, Aug 11	Bioinformatics Tools for DNA Analysis
9:00-9:30	Continental Breakfast
9:30-10:45	Teacher Background: Analyzing DNA Sequences
10:45-11:00	Break
11:00-12:00	Lesson 9: Analyzing DNA Sequences
12:00-12:45	Lunch
12:45-1:45	Teacher Background: Multiple Sequence Alignments, Phylogenetics & Evolution
1:45-2:45	Lesson 3: Using Bioinformatics to Study Evolutionary Relationships
2:45-3:00	Break
3:00-4:00	Teacher Feedback: Advanced Strand Lesson 9 and 3
4:00-5:00	End of Day Wrap Up

Thursday, August 12	Using Bioinformatics to Study Evolution
9:00-9:30	Continental Breakfast
9:30-10:45	Teacher Background: ORFinder and Open Reading Frames
10:45-11:00	Break
11:00-12:00	Lesson 4: Using Bioinformatics to Analyze Protein Sequences
12:00-12:45	Lunch
12:45-1:45	Lesson 5: Protein Structure Dictates Function: CO1 and Aspirin Metabolism
1:45-2:45	Lesson 6: Careers in Biotechnology and Related Fields
2:45-3:00	Break
3:00-4:00	Teacher Feedback: Advanced Strand Lessons 4, 5 and 6
4:00-5:00	End of Day Wrap Up

Friday, August 13	Bioinformatics Careers and Program Wrap-Up
9:00-9:30	Continental Breakfast
9:30-10:45	Career Panel: Careers in Bioinformatics
10:45-11:00	Break
11:00-12:00	Lesson 8: Presenting Results in Research Reports
12:00-12:45	Lunch
12:45-1:45	Culminating Project: Analyzing Novel Sequences
1:45-2:00	Post-workshop Survey Administration
2:00-3:15	Synthesis & Teacher Feedback
3:15-3:30	Break
3:30-5:00	End of Program Wrap Up, Stars and Wishes, Evaluation of Bio-ITEST Program

Stipend, Credit, and Clock Hours

Teachers will receive a \$1000 stipend for their participation in the two-week professional development workshop, of which \$900 will be provided August 13th, and \$100 upon completion of the field test at the end of the 2010/2011 academic year. Teachers will also receive access to specialized software and bioinformatics resources. Clock hours will be provided free of charge, and credits may be purchased through our collaboration with Seattle University. Breakfast and lunch will be provided daily.

Collaborators

Major collaborators include Digital World Biology, EdLab Group (formerly the Puget Sound Center for Teaching, Learning, and Technology), and Shoreline Community College. The program also draws on NWABR's strong relationships with school districts, community groups, bioethicists and NWABR member research institutions.